

The manuscript by Müller and colleagues presents updated global emission of methanol between 2008 and 2019. To this end, the authors use a wealth of observations, including updated methanol satellite retrievals from IASA using ANNIv4 that were also biased - corrected using aircraft observations, an optimized version of the MAGRITTE model that incorporated the production of methanol through the $\text{CH}_3\text{O}_2 + \text{OH}$ reaction as well as an improved land uptake by updated dry deposition velocities that better represented those from field studies, and independent in situ data (including ground, aircraft and FTIR) to evaluate the model optimization. The authors did a fantastic job on the writing and structuring this paper and walking us through all the steps in a clear way, thank you! Below are a few big picture comments/questions and minor suggestions.

L95-97. The cited work by Clarisse et al. (2023) was based on NH_3 retrievals. What are the specific parameters and corrections that ensure HRI consistency for methanol during the regularization process?

L106 onwards: How is the methanol retrieval impacted by using a single vertical a-priori profile for land? Methanol is a longer-lived species (~5 days) and its vertical profile can change based on injection height due to fire plume injection (large wildfires) or deep convection processes (like in the Tropics). How has this been evaluated in your retrievals. What is the uncertainty that this bring into the columns estimates and the global inventory? This is very briefly discuss in ~L400-405.

Fig 1. Out of curiosity, how much variability is there in the IASI AVK in land and the ocean? Are there regions or seasons that show large sensitivity biases from the average profile? What would that mean for the retrievals in those regions?

Section 2.2. Is there a reason why the aircraft datasets selected for the bias correction are all in the U.S.? Would it be helpful to have a more diverse representation of the global regions (i.e., Amazon, Asia?) to perform a bias correction that would be applied to global data? – this is discussed in the conclusions!

L148: rationale for excluding urban and fire plumes: but even low-resolution models (2x2.5) show evidence of large urban or wildfire plumes unless those are also excluded from the model configuration (not the case as described in Sec. 2.5.1). Please explain how the removal of those observations impacts the results *sp. bias-correction.

About overestimations after bias-correction – throughout the paper, the authors note that for large columns, the bias correction leads to an overestimation of the columns. What does Figure 8 look if including data from the Arctas campaign? Is a linear regression enough for this bias correction? If this exercise is not possible due to model output availability, it

would be good to have a discuss about future directions where more datasets on higher latitudes can be included for the bias corrections.

Minor:

L267: is Gamma_SM a typo?

Figure 4. Minor: would it be helpful to have the details from L345-350 as insets in Figure3?

L397: I thought regularized IASI data was used for the study.

Figure 5: I believe that more context and/or explanation of what this figure shows would improve the manuscript. See the question above about using a single vertical profile and sensitivity dependencies.

L419-420: I am curious what source can exist there that are have not traditionally be accounted for (thus the need to increase emissions by such large factors)

Fig 6 and Fig 9: This is minor, but the direction of the panels is flipped between the two figures: Figure 6 shows the obs, a priori and optimized vertically, while Fig 9 shows it horizontally.

L505. Isn't panel i. SH Africa? Should this instead be (h and j).

L523-524: Can you say more about how the estimates of methanol pyrogenic emissions presented here might be impacted by the earlier IASI overpass time (9:30 am) when most fires have not started or re-activated yet?

L564-565: This sentence is a bit confusing. I understand the gist of it, but re-writing is needed. One suggestion would be to add "Using" at the beginning of the sentence.

L568 and L643: What about the for GoAmazon? Is that really a negligible bias? The model completely misses the vertical profile of methanol (in both the a prior and optimized), so is there really an improvement?

L575: Does this mean that this top-down emission estimate overestimate biogenic emissions in this region (and others that do not have stringent controls on VCP?)?

L595: About ARCTAS-July and the exercise where you added fire observations (removed the CH3CN filter): if the injection heights for those plumes are underestimated (as they usually are), then the model columns would be overestimated if the AVK is applied - since the instrument is more sensitive to CH3OH when its lofted higher in the atmosphere (Fig 1). Could this be a cause for the overestimation?

Figure 13: This figure might convey better information if datapoints were colored or grouped by location, since that's where most of the variability is observed (as discussed by the text).

L680: Since it's known that the IASI columns that are biased corrected are too high for boreal regions, and that anthropogenic emission might be underestimated in Asia, this number should come with that warning (i.e., an upper bound due to x, y and z) or a margin of certainty [137 – 160] Tg yr⁻¹

L690: Could this be the reason for the overestimation in other Boreal forest?